MicMac Farms Store and Trading Co. Ductless Heat Pump Research Project

It's Up In The Air

2012-14

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Fire and Ice

Maine Rural Partners

Emera Maine

MicMac Farm Store USDA Innovation Grant

- USDA Innovation Grant obtained to install ductless heat pumps in Farm Store building.
- Ductless heat pumps installation bid solicited.
- 4 Fujitsu AOU15RLS2 heat pumps installed by Fire ‘n Ice of Ashland, ME.
- eMonitor™ installed to monitor electricity by circuit for heat pumps, boiler, and total use.
- Electricity and heating oil usage monitored and costs compared.

MicMac Farms Store Project Review

- 2011 Heating Oil Consumption = 1471 gal
- 2011 Heating Oil Cost = $4,285

Goals for 2012 Project:

- Reduce Heating Costs
- Reduce Environmental Impact from Heating
- Use Energy Resources More Efficiently

Why Heat Pumps?

- Oil Heating
  - 1 Gallon In, 0.8 Gallons Out = **80% efficient**
- Ductless Heat Pumps
  - 1 kWh in, 3 kWh out as heat = **300% efficient**
  - Environmentally friendly electricity can power Heat Pumps

Fujitsu AOU15 RLS2 Heat Pump

Outdoor Unit

Indoor Unit

MicMac Farms Store and Trading Co.

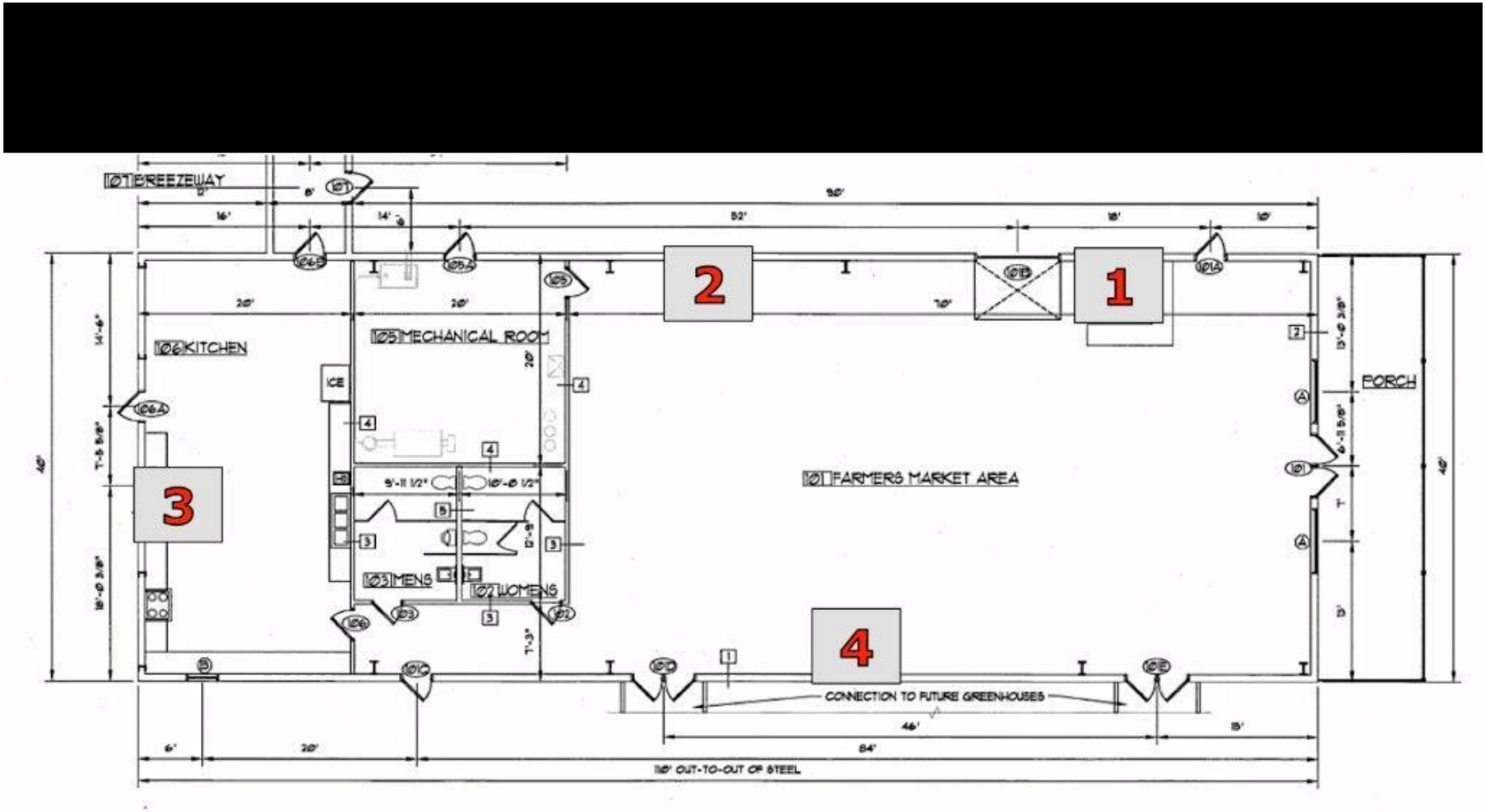
Caribou, Maine

Inside View – Farmers Market

Farmers Market Heat Pump

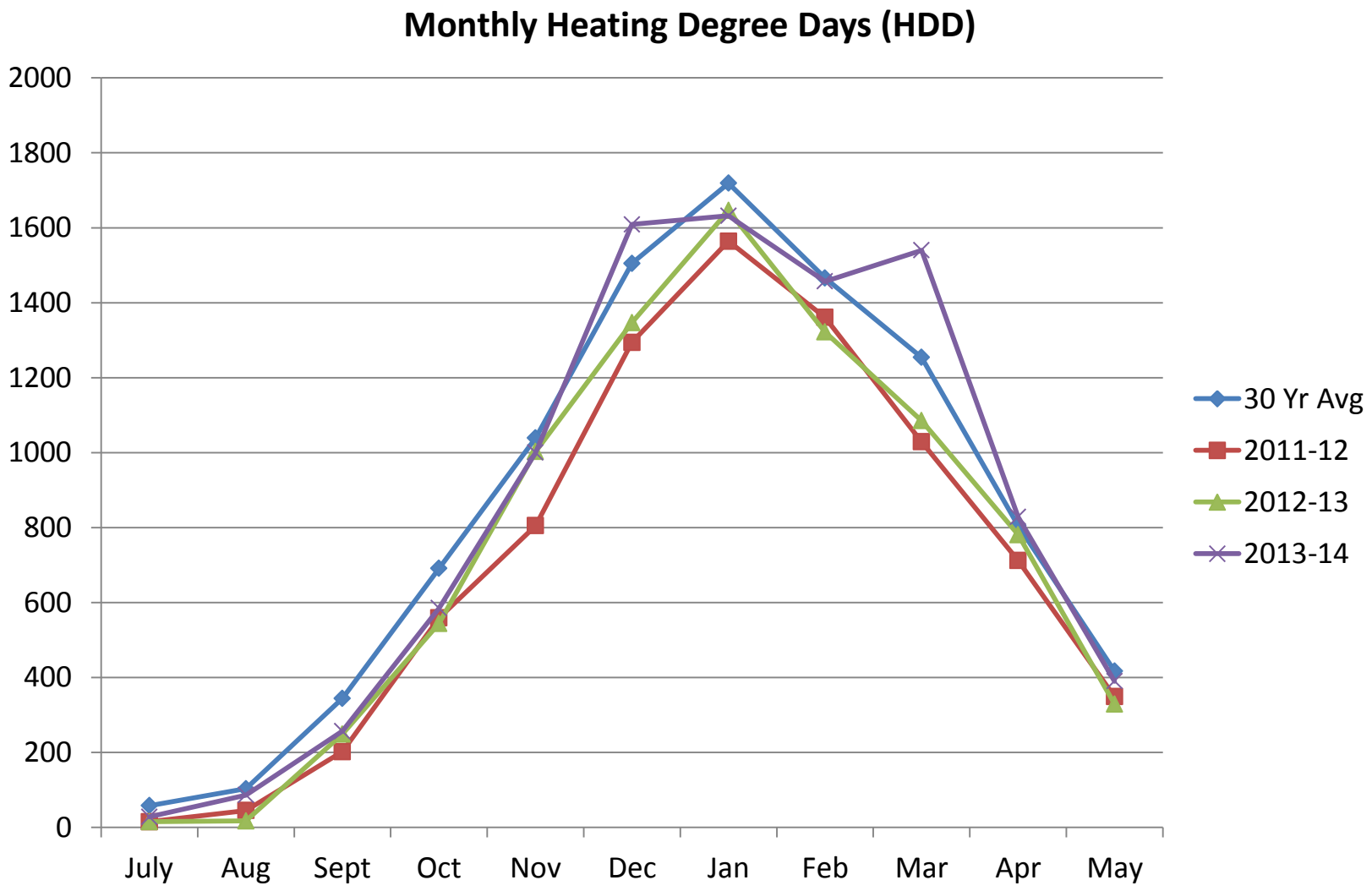
Inside View - Kitchen

Farm Store Heat Pump Placement

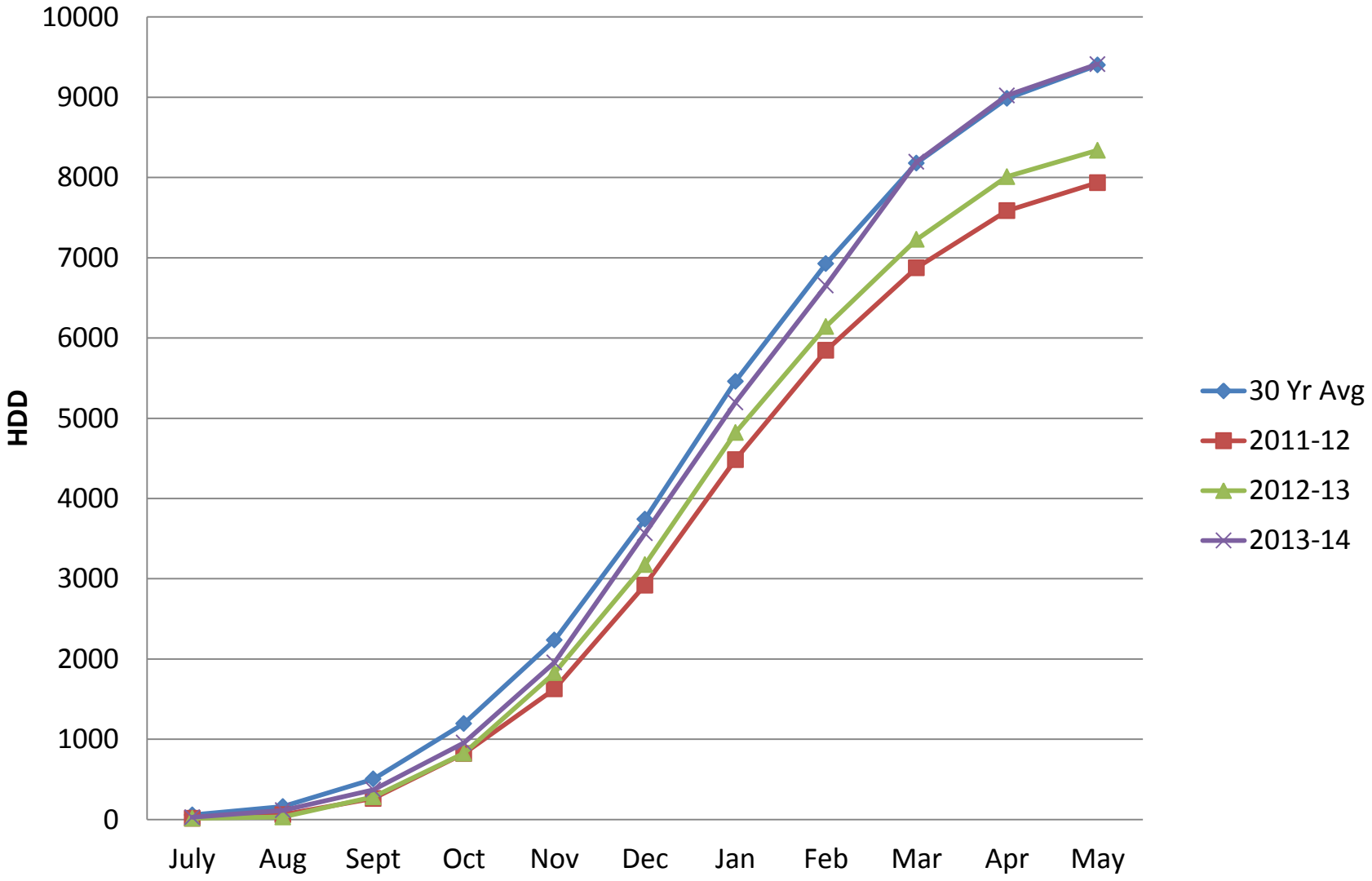


eMonitor Views

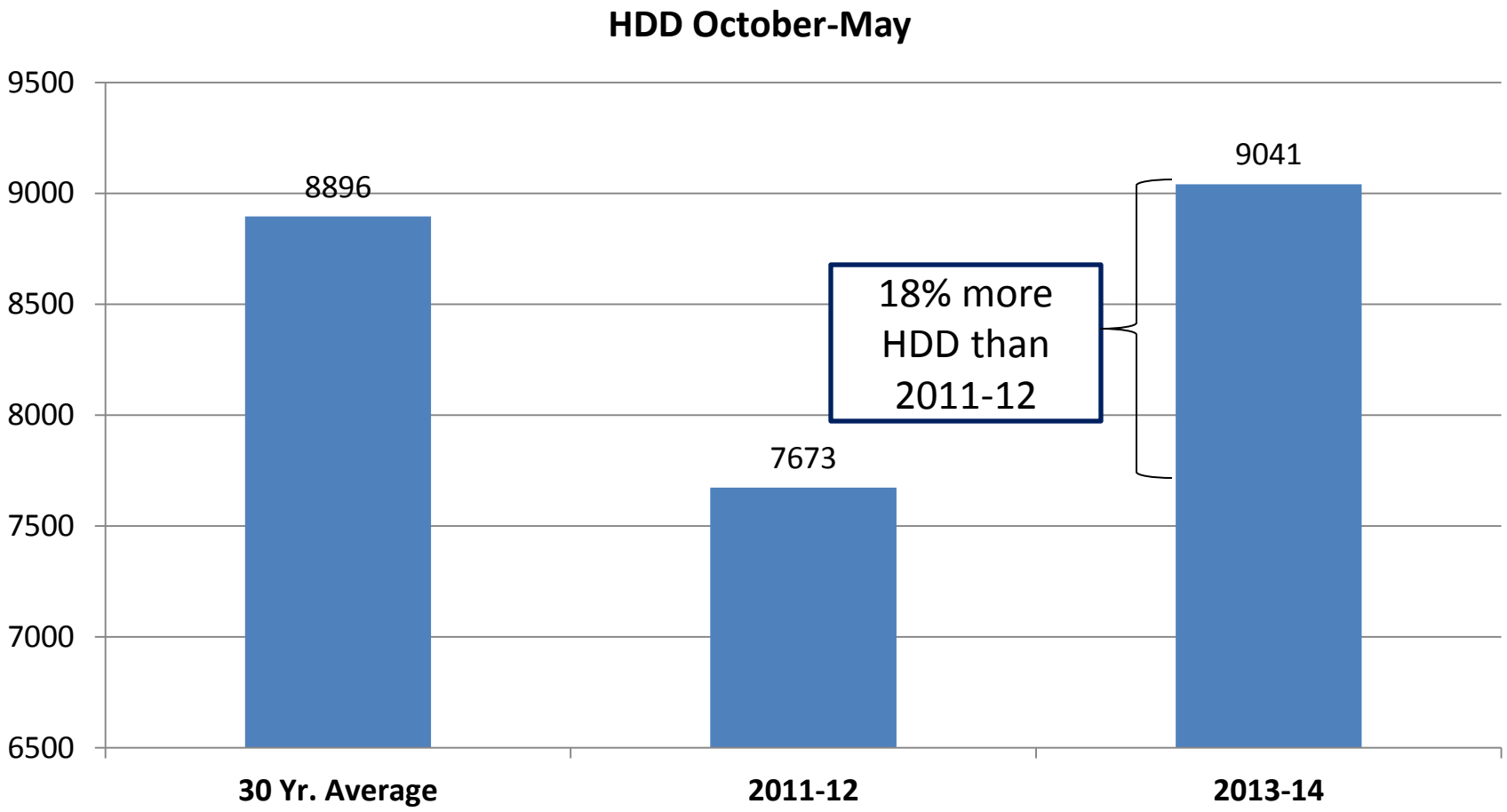
Heating Degree Days (HDD)



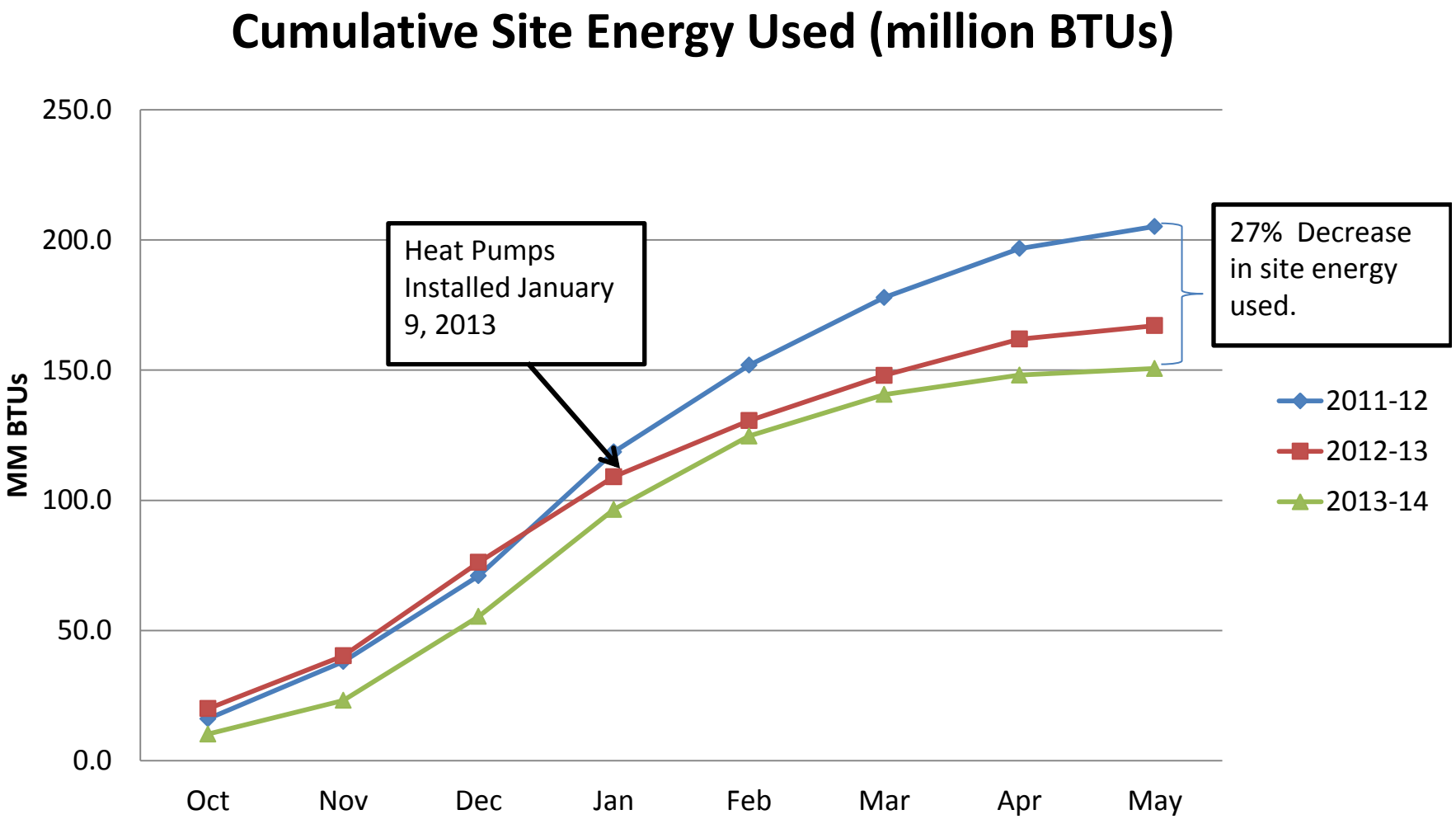
Cumulative Caribou Heating Degree Days



HDD Comparison to 2011-12 Winter



Improved Energy Usage

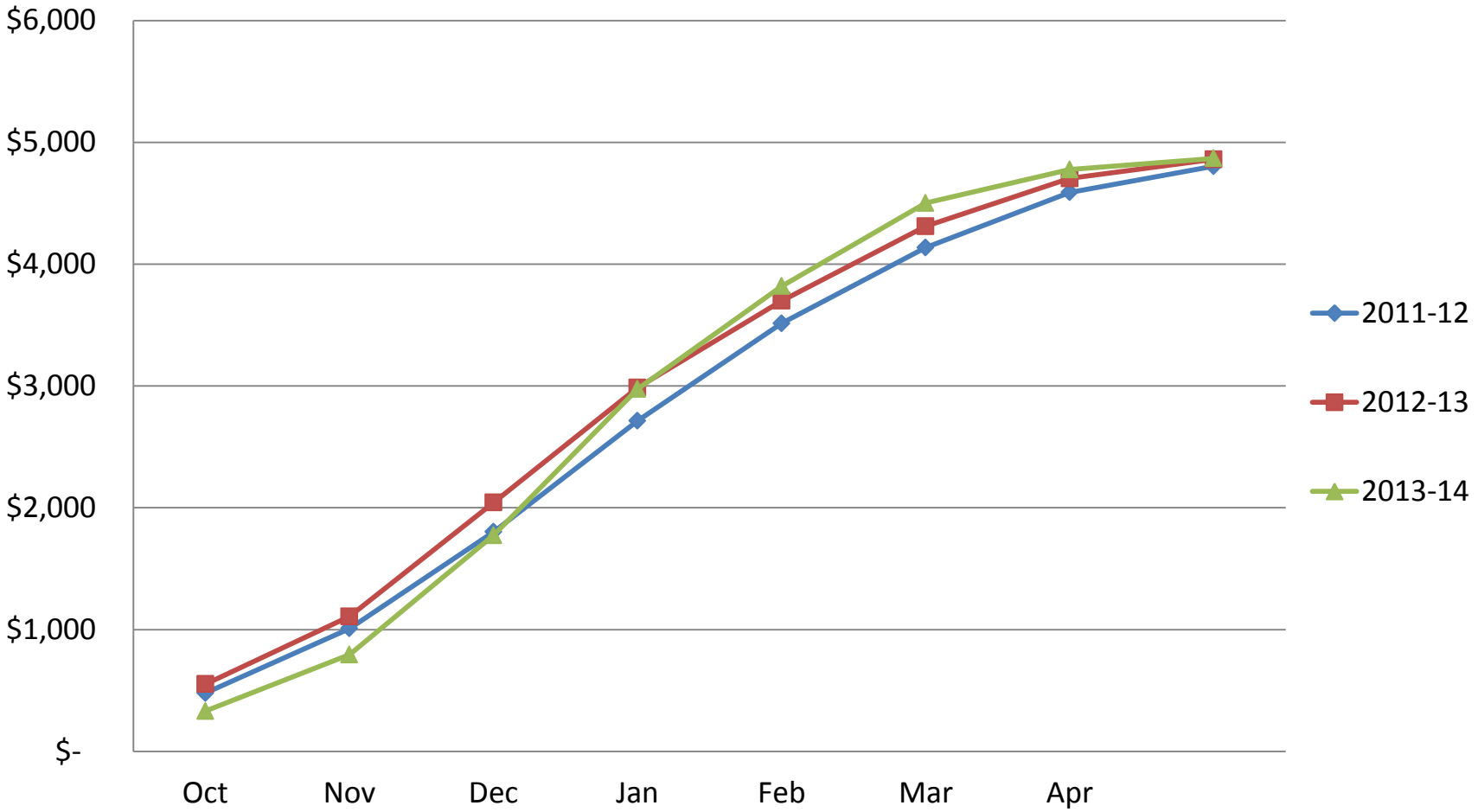


Monthly Energy Usage

	2011-12		2012-13		2013-14	
Month	**Oil Gal**	**Elect kWh**	**Oil Gal**	**Elect kWh**	**Oil Gal**	**Elect kWh**
Oct	116	606	116	1166	29	1818
Nov	143	374	134	484	49	1820
Dec	229	314	249	408	185	1923
Jan	336	405	203	1423	248	1972
Feb	230	325	97	2351	164	1581
Mar	180	300	62	2591	36	3218
Apr	129	235	58	1738	14	1622
May	55	188	23	583	10	355
Total	**1417**	**2747**	**941**	**10744**	**735**	**14309**

Heat Pumps Installed January 9, 2012

Cumulative Energy Cost



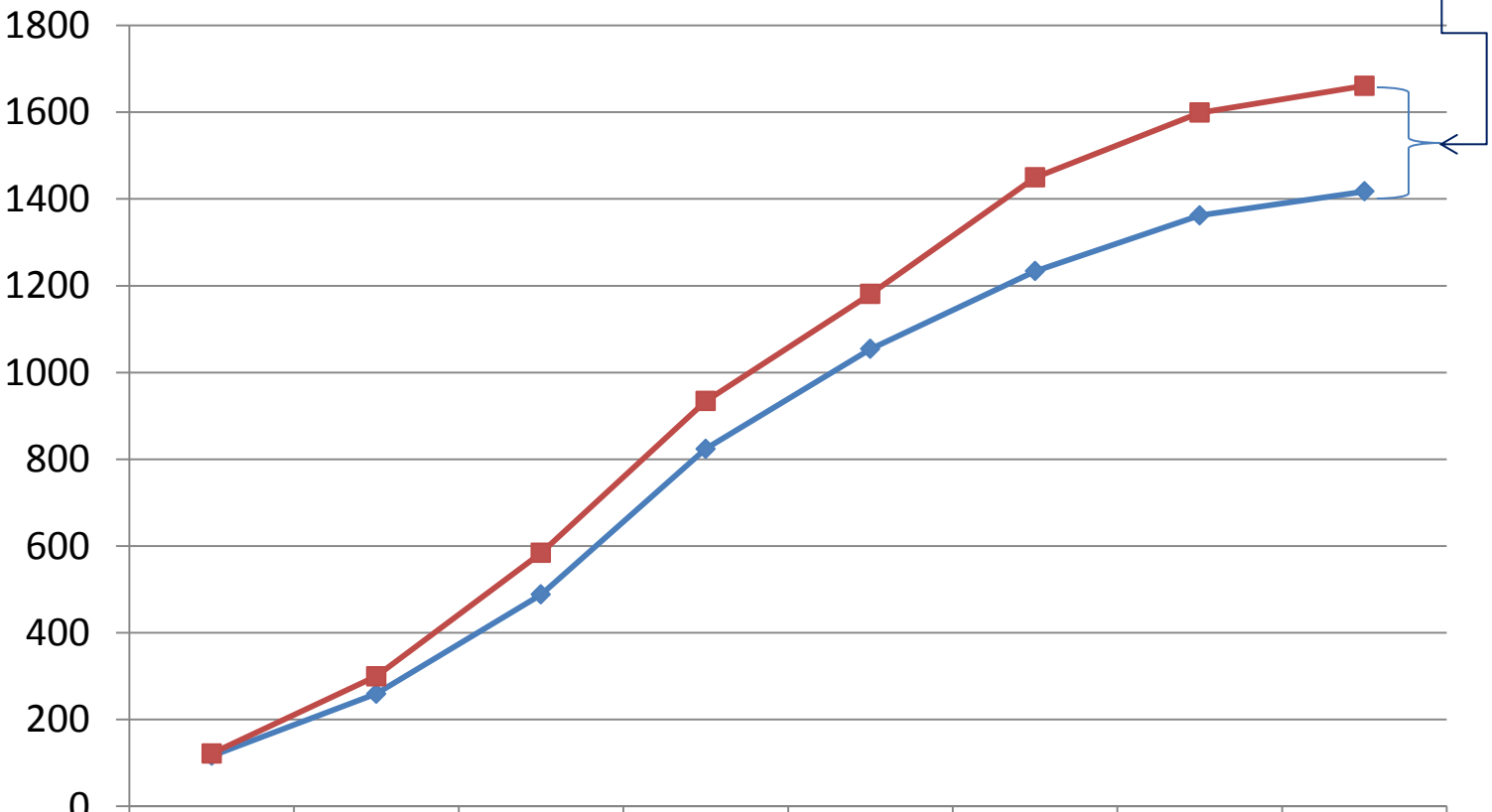
Monthly Energy Costs
October - May

	2011-12			2012-13			2013-14		
Month	**Oil**	**Electricity**	**Combined**	**Oil**	**Electricity**	**Combined**	**Oil**	**Electricity**	**Combined**
Oct	$ 369	$ 110	$ 478	$ 403	$ 149	$ 552	$ 98	$ 233	$ 331
Nov	$ 457	$ 73	$ 530	$ 468	$ 87	$ 556	$ 166	$ 297	$ 463
Dec	$ 729	$ 64	$ 793	$ 859	$ 77	$ 935	$ 651	$ 328	$ 979
Jan	$ 835	$ 78	$ 913	$ 716	$ 228	$ 944	$ 880	$ 322	$ 1,202
Feb	$ 734	$ 65	$ 800	$ 344	$ 367	$ 712	$ 585	$ 258	$ 843
Mar	$ 573	$ 51	$ 623	$ 208	$ 405	$ 613	$ 121	$ 561	$ 683
Apr	$ 410	$ 43	$ 452	$ 177	$ 216	$ 393	$ 45	$ 231	$ 276
May	$ 179	$ 37	$ 216	$ 76	$ 81	$ 157	$ 31	$ 60	$ 92
Total	**$ 4,285**	**$ 520**	**$ 4,805**	**$3,251**	**$ 1,610**	**$ 4,862**	**$2,578**	**$ 2,291**	**$ 4,869**
Avg Price	$ 3.023	$ 0.189		$3.455	$ 0.150		$3.509	$ 0.160	

Cumulative 2011-12 Oil Projection with 2013-14 HDD

(HDD14/HDD12)*gal. oil monthly

Projected **244 gal. oil increase** with 2013-14 HDD.



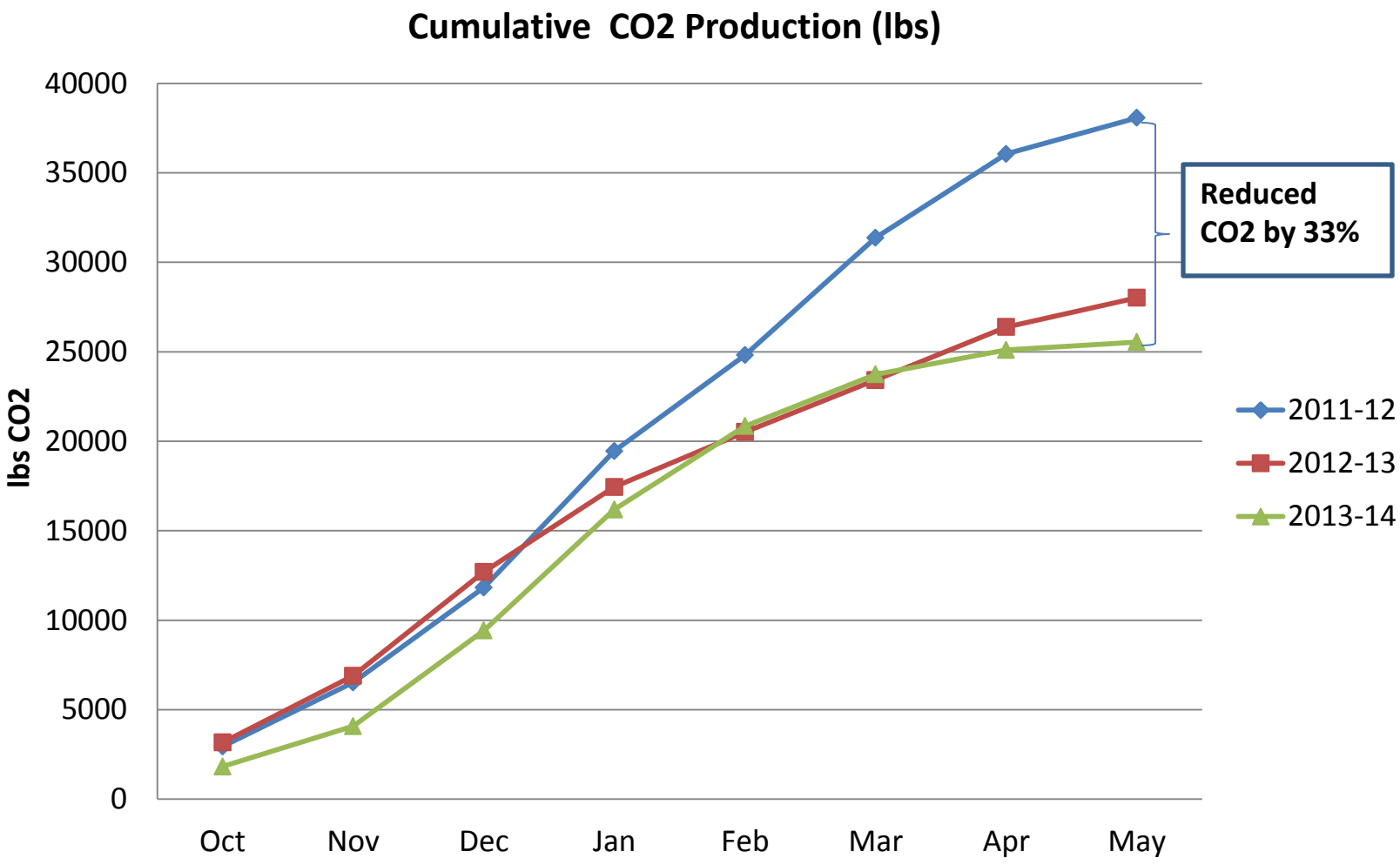
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
2011-12 Actual	116	259	488	824	1054	1234	1362	1417
2011-12 Projected	121	299	584	934	1181	1450	1599	1661

Simple Payback from Savings from Higher Oil Prices and HDDs

2011-12 Actual	2013-14 Projection
1,417 gal. oil used	1,661 gal. oil projected
X $3.0232/gal. avg. cost	X $3.5094/gal. avg. cost
==========	==========
$ 4,284 actual oil cost	**$ 5,829 projected oil cost**
	Savings = $1,545

Oil Price Change 2011-12 to 2013-14 = **16.1% increase**
Oil Usage Projected Change 2011-12 to 2013-14 = **17.2% increase**
Avoided Oil Cost 2011-12 to 2013-14 = **$1,545 or 36% increase**
Heat Pump Bid: = $14,228
Annual "savings": = $1545
Payback: = $14,228/$1545 per year = **9.2 years simple payback**

Environmental Improvement
CO2 Produced from Heating



Summary of Findings
2013-14 vs. Base Yr. 2011-12

- Increased HDD of 18% - required more heat
- Reduced projected heating cost by $1545
- Payback of 9.2 years based on 2014 savings
- Reduced Total Site Energy (MMBTU) used by 17%
- Reduced Actual CO2 production by 33%

- NRCS Grant Disclaimer:
  - This material is based upon work supported by the Natural Resources Conservation Service, U.S. Department of Agriculture, under number 69-1218-2-27
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